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COSTS AND RETURNS OF TECHNICAL EDUCATION, A PILOT STUDY.

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THE OBJECTIVES OF THIS STUDY WERE (1) TO OBTAIN ESTIMATES OF COSTS AND RETURNS OF TECHNICAL EDUCATION, (2) TO COMPUTE SOCIAL AND PRIVATE RATES OF RETURN ON INVESTMENTS IN TECHNICAL EDUCATION, AND (3) TO COMPARE THESE WITH ESTIMATES OF THE RATE OF RETURN ON GENERAL EDUCATION AND INVESTMENTS IN TANGIBLE CAPITAL. COSTS AND RETURNS WERE MEASURED BY COMPARING EARNINGS OF A GROUP OF 45 WHITE MALE GASTON TECHNICAL SCHOOL GRADUATES WITH EARNINGS FOR A GROUP OF 45 WHITE MALE HIGH SCHOOL GRADUATES HAVING SIMILAR CHARACTERISTICS. THE COMPARISON COVERED A 7-YEAR PERIOD. THE ESTIMATED AVERAGE TOTAL COST TO SOCIETY FOR THE TWO YEARS OF TECHNICAL EDUCATION WAS $7,425 PER STUDENT WHICH INCLUDED $5,197 FOR LOSS IN PRODUCTIVITY WHILE IN SCHOOL AND $2,228 FOR COSTS OF PROVIDING SCHOOL FACILITIES, SUPPLIES, AND PERSONNEL. THE AVERAGE TOTAL PRIVATE COST PER STUDENT FOR THE TWO YEARS OF TECHNICAL SCHOOLING AMOUNTED TO $4,920. THE AVERAGE ANNUAL INCOME FROM INVESTMENT IN TECHNICAL EDUCATION INCREASED FROM $553 IN THE FIRST YEAR AFTER SCHOOLING TO $1,036 IN THE FOURTH POST-GRADUATE YEAR. THE ESTIMATED SOCIAL RATE OF RETURN ON INVESTMENTS IN TECHNICAL EDUCATION WAS 16.5 PERCENT AND THE PRIVATE RATE, 22 PERCENT, ASSUMING THAT PER CAPITA REAL EARNINGS WOULD INCREASE OVER TIME AT THE RATE OF 2 PERCENT PER ANNUM. (PA)

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# COSTS AND RETURNS OF TECHNICAL EDUCATION: A PILOT STUDY

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# Costs and Returns of Technical Education:

# A Pilot Study

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# SUMMARY AND CONCLUSIONS

This study was conducted for the purpose of measuring costs and returns of human capital created by investments in two years of post-high school, technical education. The study design was focused on three of the major problems in measuring the income effects of education: (1) separation of property income and labor earnings, (2) measurement of the income effects of technical education net of the income effects of other characteristics which are correlated with level of education, and (3) treatment of direct nonmonetary costs and returns of education.

Data were obtained from a group of 45 high school graduates and 45 graduates of Gaston Technical Institute which is located in Gastonia, North Carolina. All were white males graduating from high schools in North Carolina. High school and Gaston Tech graduates were selected in pairs so that members of each pair were high school classmates, graduating in the same year with very similar high school academic records. Graduates were not included in the study if they had formal post-high school education or training other than two years at Gaston Tech, had permanent disabilities affecting employability, or had migrated more than 200 miles from the community where they graduated from high school. To insure a market measure of the effect of technical education on the value of labor services, persons who were self-employed or employed solely in military service during the study period were also excluded from the sample.

Further standardizing of income data for variations in ability, experience, and other income related variables was accomplished by multiple regression analysis. Each of the variables considered had

a statistically significant effect upon the level of monthly income, and 55 percent of the variation in income was accounted for by regression.

The estimated average total cost to society for the two years of post-high school technical education was $7,425 per student. The estimated monetary value of productivity lost while students were obtaining technical education averaged $5,197, or 70 percent of the total cost. The remaining $2,228 was for costs of providing school facilities, supplies and personnel. The average total private cost per student for the two years of technical schooling amounted to $4,920. Average government transfer payments, consisting of G. I. Bill ($1,028) and unemployment ($19) payments, reduced the average private cost of foregone earnings from $5,197 to $4,150 per student, 84 percent of total private cost. The remaining private costs consisted of expenditures for tuition, books and miscellaneous school supplies, $770. The balance of costs for operating the technical school was financed through state appropriations, $1,458.

The monetary returns on investments in technical education began to accrue to Gaston Tech graduates during the first year after completion of technical schooling. The average annual income from investment in technical education increased from $553 in the first year after schooling to $1,036 in the fourth post-graduate year. Total return per student for the first four years after graduation amounted to 65 percent of the average private investment.

The estimated social rate of return on investments in technical education was 16.5 percent and the private rate 22 percent, assuming that per capita real earnings would increase over time at the rate of

2 percent per annum. When zero growth in the income advantage of Gaston Tech graduates was assumed, the estimated social rate of return was reduced to 11.7 percent and the private rate to 16.9 percent.

These rates of return do not include two types of benefits from education. Any satisfaction which Gaston Tech graduates derive from their technical education in addition to the monetary gain has not been measured. Fringe benefits were examined only in enough detail to indicate that Gaston Tech graduates have an advantage in fringe benefits which may be worth several hundred dollars annually. The external effects which other people may experience as a result of the technical education received by Gaston Tech graduates were also unmeasured. Apparently the technical education obtained by the Gaston Tech graduates pays a high rate of return even if only the direct pecuniary returns are considered. If the indirect and nonmonetary returns could have been evaluated accurately, the social and private rates of return probably would have been much higher.

How large are the estimated social and private rates of return on investments in the technical education of Gaston Tech graduates when compared to the rates estimated for other investments? Such comparisons are difficult to make, and those which follow are more illustrative than substantive. Stigler has estimated the private rate of return on capital invested in manufacturing industries to be 7.5 percent for the period 1939-1956.[1] Using census data Becker

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[1]George J. Stigler, Capital and Rates of Return in Manufacturing Industries, Princeton University Press, 1963, p. 34.

estimated a private rate of return of 14.5 percent on investments in college education by native-white urban males who graduated in 1939.[2] His estimate of the private rate of return to 1949 graduates was 13 percent. Becker's estimates were based on cross-sectional data and a growth rate of slightly over one percent.

Using Stigler's results, Becker estimated the social rate of return on manufacturing capital to be 12 percent, compared to social rates of return on investment in college education which were 12.5 and 13.0 percent.[3] Thus, both the social and private rates of return estimated for investments in the technical education by Gaston Tech graduates compared favorably with the rates estimated for investments in manufacturing and college education.

The results of the present study should not be used to infer that there has been or is underinvestment in technical education. Two characteristics of the study limit the inferences which can be made. First, the study is a pilot effort covering a group of graduates from a single technical school. Thus, the rate of return estimated for these Gaston Tech graduates should not be used as an estimate of the rate of return on aggregate investment in technical education.

Second, Gaston Tech was the first technical institution of its kind to be established in North Carolina. The school was converted

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[2] G. S. Becker, Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education, National Bureau of Economic Research, New York, 1964, pp. 75-78.

[3] Ibid., pp. 118-120.

into a two-year technical school in 1957. Because it was the first such school in North Carolina, the first two graduating classes at Gaston Tech may have experienced less competition than subsequent graduates for the employment opportunities available to people with technical skills. The supply and demand for technically trained manpower have undoubtedly changed since the data were collected. Numerous institutions which offer technical training similar to Gaston Tech have been established in North Carolina since 1957. Thus, the rate of return on current investments in technical education may not be the same as that estimated for members of the first two graduating classes at Gaston Tech.

Although the study is limited in scope, some of the results should be carefully noted. First, the study represents a relatively intensive effort to determine the effect of education upon income, net of the effects of other variables often associated with investment in education, by using matched pairs of high school and Gaston Tech graduates plus regression analysis. The size and significance of the regression coefficients are indicative of the importance of standardizing for the income effects of other variables associated with investments in education.

Second, fringe benefits should be taken into account in estimating the returns to investment in education. Although it is difficult to place a value on fringe benefits, certainly any gain in fringe benefits that can be associated with education is more easily measured than consumption or external effects of education. It is quite possible that the income gain in the form of fringe benefits constitutes a greater

fraction of total returns to individual investors in technical education than the often mentioned consumption benefits.

Finally, the study is another piece of evidence which supports previous findings of high rates of return on investments in education. Investment in a specific type of education, technical schooling, has been examined and found to yield a favorable rate of return to Gaston Tech graduates relative to the rates yielded by other selected investments.

## BACKGROUND

Economists have been aware for many years that education has economic value and may be considered as a form of investment in human beings.[4] However, it was 1935 before Walsh published the results of a careful study of the economic value of education.[5] Following Walsh's work there was a lag of almost two decades before additional studies were made of the economics of education.[6] Recent efforts have been concerned with the value of general education at primary, secondary and college levels. Relatively little effort has been devoted to the study of technical and industrial training except for a few studies of retraining

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[4]Some notable early examples include: Adam Smith, An Inquiry into the Nature and Causes of the Wealth of Nations, fifth edition, Random House, Inc., New York, 1937, pp. 265-266; J. S. Mill, Principles of Political Economy, seventh edition, Longmans, Green and Company, New York, 1909, p. 108; Alfred Marshall, Principles of Economics, eighth edition, McMillan and Co., LTD, London, 1920, p. 469.

[5]J. F. Walsh, "Capital Concept Applied to Man," Quarterly Journal of Economics, Vol. 49, 1935, pp. 255-285.

[6]Some of the more admirable attempts to measure the value of education empirically were: Ernest Havemann and P.S. West, They Went to College, Harcourt, Brace and Co., New York, 1952; Dael Wolfle and J. G. Smith, "Occupational Value of Education for Superior High School Graduates," Journal of Higher Education, Vol. 27, 1956, pp. 201-213; H. S. Houthakker, "Education and Income," Review of Economics and Statistics, Vol. 41, 1959, pp. 24-28; H. P. Miller, "Annual and Lifetime Income in Relation to Education, 1929-1959," American Economic Review, Vol. 50, 1960, pp. 962-986; T. W. Schultz, "Capital Formation by Education," Journal of Political Economy, Vol. 68, 1960, pp. 571-583; W. L. Hansen, "Total and Private Rates of Return to Investments in Schooling," Journal of Political Economy, Vol. 71, 1963, pp. 128-140; Shane Hunt, "Income Determinants for College Graduates and the Return to Educational Investment," Yale Economic Essays, Vol. 3, 1963, pp. 304-357; G. S. Becker, Human Capital; A Theoretical and Empirical Analysis, with Special Reference to Education, National Bureau of Economic Research, New York, 1964; and Roy L. Lassiter, Jr., "The Association of Income and Education for Males by Region, Race and Age," The Southern Economic Journal, Vol. 32, No. 1, Part 1, 1965, pp. 15-22.

programs.[7] In this study estimates were made of the costs and returns for a group of people who invested in two years of post-high school, technical education.

The objectives in conducting the study were:

(1) To obtain estimates of costs and returns of technical education,

(2) To compute social and private rates of return on investments in technical education, and

(3) To compare the rate of return on investments in technical education with other estimates of the rate of return on general education and the rate of return on investments in tangible capital.

Costs, in terms of foregone earnings, and returns were measured by comparing earnings of a group of 45 technical school graduates with earnings for a group of 45 high school graduates. Except for level of education, high school graduates had characteristics very similar to those of technical school graduates. The comparison of incomes of technical and high school graduates covered a seven-year period. All technical school graduates successfully completed two academic years of post-high school education, enrolling in either 1957 or 1958 and graduating in either 1959 or 1960. Income data prior to the period of technical education were not obtained. Since collection of income data was terminated as of August 31, 1964, a maximum of six to seven years of income history was obtained from each person in the study.

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[7]Michael E. Borus, "A Benefit-Cost Analysis of the Effectiveness of Retraining the Unemployed," Yale Economic Essays, Vol. 3, 1964, pp. 370-429; Gerald G. Somers, "Retraining: An Evaluation of Gains and Costs," in Employment Policy and the Labor Market, edited by Arthur M. Ross, University of California Press, 1965, pp. 271-298; David A. Page, "Retraining Under the Manpower Development Act: A Cost-Benefit Analysis," Public Policy 13 (1964) 257-267; Gerald G. Somers and Ernst W. Stromsdorfer, "A Benefit-Cost Analysis of Manpower Retraining," Proceedings of the Seventeenth Annual Meeting, Industrial Relations Research Association, 1964, pp. 172-185.

Collection of data for the study began in the summer of 1963. At that time there were more than a dozen institutions in North Carolina offering two years of related course work in technical subjects. Only graduates of Gaston Technical Institute in Gastonia, North Carolina, had postgraduate income histories of more than three years. Since the amount of postgraduate income data that could be obtained from graduates of other technical schools was more limited, only graduates of Gaston Tech were included in the study.

Gaston Technical Institute was established in 1952, but the 1957-58 academic year was its first as a fully state supported institution offering two-year terminal courses in four fields of technology. Since 1957 the degree of Associate in Applied Science has been awarded to graduates in Civil, Electrical, Electronics or Mechanical and Production Technology. The program at Gaston Tech is designed to train technical manpower that can function between the engineer and the skilled craftsman. The four curricula offered at Gaston Tech have been accredited by the Engineer's Council for Professional Development. Normal enrollment at the institution is approximately 200 students, and approximately 60 percent of enrollees graduate.

From 1957 until the academic year 1965-66 the school was operated by the College Extension Division of North Carolina State University at Raleigh. In 1965, Gaston Tech was administratively merged with newly created Gaston Community College. The merging of physical facilities is scheduled for the fall semester of 1966. As a separate or identifiable institution Gaston Tech will no longer exist but Gaston Community College will offer technical curricula. In addition,

more than twenty other institutions offering courses in technical subjects have been established in North Carolina as a result of legislation passed by the North Carolina General Assembly in 1957. Collectively these institutions offer courses in technical subjects comparable to those offered by Gaston Tech. They also offer a wider range of technical curricula and numerous short-term industrial training programs.

## Obstacles

One measure of the economic effects of education can be obtained by simply comparing the incomes of people with different levels of education. This measure may be very inaccurate because people with different levels of education also differ with regard to other characteristics. Four important problems are involved in such a measure.

(1) People with higher education tend to come from the more wealthy families and probably have more income from property as a result of gifts and inheritance. The educated may also have more property income as a result of investing some of the added income earned from their education. Since investments in property are separate and distinct from investments in education, the costs and returns of such investments should be excluded from the costs and returns of education.

(2) People with higher education may have greater than average ability and, perhaps, such individuals would earn higher than average incomes even without a higher level of education. A greater than average ability level may be inherited or may be the result of

investments in human capital in forms other than education.[8] The primary concern in measuring the costs and returns of higher education is to obtain measures which have been standardized for level of ability.

(3) Returns to education take not only the form of increased salaries or wages, but may include fringe benefits such as employer sponsored insurance programs, more desirable working hours, longer paid vacations, more paid sick leave, etc. Since it is difficult to measure and transform these fringe benefits into money terms, this element of returns is often ignored. Expenditures on education may be made not only to increase future income (investment) but also to increase present and future satisfaction (consumption). Little progress has been made in separating the investment and consumption elements of education.

(4) There are effects of education, both monetary and non-monetary, which are external to the student. All members of a family may benefit from investments in education by one of its members. Similarly, many members of a community or a society may benefit from the education of other citizens. These external effects are difficult to identify and measure.

These problems have, of course, been faced by others who attempted to measure costs and returns of education. The income data used in earlier studies of general education have included property income.

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[8]The most important ways that people may raise their level of production include investments in education, health, migration, market information and occupational training.

Thus, little progress has been made in relation to the first obstacle, other than a recognition that property income introduces an upward bias in the estimated value of education. Several attempts have been made to standardize incomes for different levels of ability prior to estimating the value of education. These attempts have been handicapped by the difficult problem of identifying and measuring ability and by the limited amount of suitable income data. Income data by level of education and level of ability (where ability has been measured prior to the last increment of schooling) are required.

Even the level of education and amount of investment are usually underestimated for three reasons: (1) the Census Bureau reports only the highest grade completed without indicating the number of academic years required to successfully complete a given level of education; (2) education higher than four years of college is not reported by level completed; (3) several types of education are unreported in census data. For example, time spent in vocational, trade, and business schools is not reported.[9]

Studies of the economic value of education have been limited generally to estimating monetary costs and returns. Usually external effects have been ignored because measurement difficulties were involved. The methods used in the current study of costs and returns of technical education are very similar to past studies with regard to nonmonetary direct effects and external effects. Direct nonmonetary effects of

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[9]Jacob Mincer, "Investment in Human Capital and Personal Income Distribution," Journal of Political Economy, Vol. 66, 1958, p. 291.

technical education were ignored with one exception. Some crude measures of the fringe benefits associated with the occupations of Gaston Tech and high school graduates were obtained.

Most of the effort in the current study was devoted to techniques for dealing with obstacles (1) and (2) above. Thus, the study was designed to cope specifically with factors which were considered as sources of bias in the monetary income effects of education. Three techniques were used to eliminate bias due to such factors:

(1) The scope of the study was restricted to eliminate several variables.

(2) Some variables which are usually correlated with education and income were controlled so the means and distributions were approximately the same for the 45 high school graduates as for the 45 Gaston Tech graduates.

(3) Multiple regression techniques were used to estimate the income effect of education net of the influence of variations in several related factors which also affect incomes.

Unfortunately when the scope of a study is reduced by eliminating variables from consideration, the bases for drawing certain inferences regarding the study results are also eliminated. Information regarding certain interesting variables was simply unavailable for Gaston Tech graduates. For example, all of the 1959 and 1960 graduates at Gaston Tech were white males, making it impossible to analyze the costs and returns of technical education by race and sex. Other variables, such as physical disability, other formal education and self employment, were voluntarily excluded because the researchers anticipated insufficient information for adequate analysis.

## Sample Criteria

The first two methods were implemented by prespecifying certain characteristics of persons to be used as a source of income data. The following criteria were used.

(1) Each participant could have only the specified high school or technical education, except for military training not closely related to the individual's occupation. Thus, income data for persons with other investments in formal education or training beyond the high school level were eliminated.

(2) Each high school graduate selected had to have a high school academic record comparable to that of his classmate who attended Gaston Tech. Gaston Tech graduates were dropped from the study if a qualified high school classmate was unavailable. Any difference in the level of ability for the two groups should be minimized since each high school graduate was selected on the basis of a high school academic record comparable to the classmate who went to Gaston Tech. By choosing high school graduates from the same high schools, the quality of high schools and probably the geographic backgrounds represented in the two groups were balanced.

(3) Each person had to be a civilian and employed or seeking employment. If employed, the person must have been employed by someone other than himself but not by a relative. A requirement that persons be in the civilian labor force was necessary to get a market measure of the productivity of high school and Gaston Tech graduates. By excluding persons who were self-employed or working for relatives, the estimated income effects of education should not be biased by property income or nepotism.

(4) Each participant could have no permanent disabilities which would obviously limit his range of employment possibilities. Physically disabled persons may reap unusually large returns from investments in education because of their forced dependence on mental capabilities rather than physical capabilities. Since the possibility of unusually high returns could not be investigated adequately in the study, the permanently disabled were excluded.

(5) Each person had to be a graduate of a North Carolina high school and employed no more than 200 miles from the community where he graduated from high school. This requirement helped to reduce the cost of collecting data and to make the two groups more homogeneous.

Some of these restrictive criteria did not result in complete exclusion of individuals from the study. Since conditions of employment frequently change, persons could fail to meet specifications concerning employment for periods of various length. Income data were not used for any individual during a period in which some requirement was unsatisfied. Individuals who provided less than 30 months of unrestricted income data were dropped from the study.

## Use of Regression

Several factors which affect incomes were not controlled in the collection of data, and some factors which determine ability levels (particularly investments in forms of human capital other than education) could not be balanced between the two groups. Variables were formulated to represent variations in migration, health care, job information, work experience, and quality of education. Some variables which had been controlled in the collection of data were also used in the regression to aid in the interpretation of the study results.

Variables were assumed to have a linear relatioship to income. Thus, the regression equation estimated was of the form:

$$Y = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10}.$$

Monthly income (Y) is equal to some constant (a) plus some multiple ($b_i$) of each of the independent variables ($X_i$) in the equation. The variables represented by X's are:

$X_1$ - technical education,

$X_2$ - high school grade average,

$X_3$ - age,

$X_4$ - mother's education,

$X_5$ - residence during high school,

$X_6$ - military service,

$X_7$ - migration from home community,

$X_8$ - size of high school class,

$X_9$ - trend for Gaston Tech graduates,

$X_{10}$ - trend for high school graduates.

Technical education ($X_1$) was used as a variable by assigning the value of zero for high school graduates and one for Gaston Tech graduates. The coefficient of technical education ($b_1$) is the estimate of the income effect of technical education immediately after graduation holding constant all other variables in the regression equation. Miller's studies have indicated that the difference in average income of college graduates and high school graduates increases with the number of years of employment experience.[10] Consequently, two trend variables were used in the

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[10] H. P. Miller, Income of the American People, J.W. Wiley and Sons, New York, 1955, and "Lifetime Income and Economic Growth," American Economic Review, Vol. 55, 1965, pp. 834-844.

regression equation, one for Gaston Tech graduates ($X_9$) and one for high school graduates ($X_{10}$). The difference in the two trend coefficients ($b_9 - b_{10}$) is the estimated change in earnings of the two groups over time. The two trend variables were measured in months after the Gaston Tech member of each pair had graduated from technical school. High school graduates were given a zero for the Gaston Tech trend variable ($X_9$) and Gaston Tech graduates were given a zero for the high school trend variable ($X_{10}$).

The other variables in the regression equation represent various characteristics that can affect earnings. High school grade average ($X_2$) was used as one measure of ability and motivation. High school graduates were selected on the basis of a grade average comparable to that of the classmate who went to Gaston Tech. Nevertheless, perfect matching was impossible, and the variable was included in the regression equation to further standardize on ability and motivational differences as measured by grades.

High school grade average was formulated as a grade point ratio. The grade point ratio represents the average grade per unit of academic credit. Ratios were computed by assigning the following weights to grade classifications: A (superior) - 4, B (excellent) = 3, C (good) = 2, D (fair) = 1, F (failure) = 0. The grade weights multiplied by the number of credits for each grade were summed and divided by the total number of credits to obtain the grade point ratio.

Age ($X_3$) was also balanced for the two groups since pairs of high school and Gaston Tech graduates were selected from each high school graduating class. Nevertheless, an estimate of the effects of maturity

and work experience on earnings was desired. Age at time of enrollment in Gaston Tech was selected as the variable to represent both these characteristics. As a group, Gaston Tech graduates had more active duty in the armed forces than high school graduates. Thus, military service ($X_6$) was included to represent the variations in civilian employment due to military service. Military service was measured as the number of months of active duty.

Mother's education ($X_4$) was included to reflect variations in the quantity and quality of family investments in the informal education, physical and emotional health, motivation, and market information of children. Father's education could have been used to represent these investments, but sample members frequently were unable to supply information regarding their father's education. Only mother's education, in years of school completed, was used in the regression.

Residence during high school ($X_5$), urban versus rural, was included to represent variations in the quantity and quality of community investments in health and recreation facilities, social environment, market information, etc. It was hypothesized that the quality and quantity of such investments would tend to increase as one goes from a rural to an urban environment. Residence during high school was assigned the value of zero if it was primarily rural and one if urban. Size of high school graduating class ($X_8$) was included to represent variation in quality of schooling. Either of the variables may have been sufficient without the other. Both were included because it was felt that the pattern of school consolidations in North Carolina may have reduced the correlation between size of high school and population density.

Migration ($X_7$) is another investment in human capital which people often make to increase incomes. The income gains from migration should be distinguished from the income effects of education. Distance migrated, measured in number of miles from place of employment to the community at which the person had graduated from high school, was included in the regression to represent variations in investments in migration. Investments in other forms of human capital after technical schooling, such as on-the-job training, should also be distinguished as investments separate from education. Since it was impossible to obtain reliable measures of such investments, the income effects of other investments in human capital after technical schooling may be mixed with the estimated income effects of technical education.

## Data Collection

Data collection began with the initial selection of Gaston Tech graduates. School records at Gaston Tech were examined to determine which of the 1959 and 1960 graduates would meet the specified requirements of the study. From a total of 120 graduates in the first two classes, 59 were considered eligible based on information from school records.

Gaston Tech administrators had maintained a fairly accurate employment record on each graduate. Consequently, information concerning the amount of post-high school education, distance migrated from high school, and other requirements was obtained initially from school records. Post-high school education prior to enrollment at Gaston Tech was the primary factor which eliminated 1959 and 1960 graduates from the sample. High school transcripts were also available for each

of the Gaston Tech graduates. These provided name and location of high school, grades, and scores on aptitude tests (if any had been administered).

The second phase of data collection was to visit each high school represented and determine if adequate high school prospects were available for each of the 59 Gaston Tech graduates. Prospective high school graduates were compared with the classmate who attended Gaston Tech primarily on the basis of high school grades. Scores on aptitude tests and subjective evaluations by high school faculty members were also considered whenever these were available.

Two general criteria were applied to determine which high school graduates would be considered as prospects and the order of preference among prospects.

(1) The student must have been considered capable of satisfactory academic performance at the post-high school level.

(2) For those who met the first criterion the order of preference was determined by the degree of similarity in overall high school records for the prospect and the Gaston Tech classmate.

Several prospects for the high school group were selected during the initial visit at the high school to avoid repeat visits whenever one of the sample restrictions prevented using the number one choice among high school prospects. If the number one choice of high school prospects could not be used in the study, the second ranked prospect was then contacted.

Prospects for both groups were contacted during the summer and fall of 1963. At the time of initial contact, information on the various sample requirements was obtained to determine if the individual should be included in the study. Whenever a Gaston Tech graduate did not meet the requirements of the study, the corresponding high school prospects were also dropped from further consideration. For this reason, Gaston Tech graduates were normally contacted and interviewed prior to making contact with high school classmates. Several of the restrictive criteria resulted in complete elimination of prospects from both groups (Table 1).

Table 1. Prospects that were eliminated after initial contact, by education

| Cause | Gaston Tech | High School |
|---|---|---|
| Other post-high school education | 2 | 36 |
| Military Service | 3 | 3 |
| Migration restriction | 3 | 2 |
| Physical handicap | 2 | 2 |
| Privately owned business | 1 | 1 |
| Would not cooperate | 1 | 1 |
| No adequate high school counterpart[a] | 2 | -- |
| Total | 14 | 45 |

[a]Applies to Gaston Tech group only.

During the interview with high school and Gaston Tech graduates four kinds of information were recorded: (1) information concerning the restrictions, (2) income and employment history from the date on which the Gaston Tech graduate enrolled for technical schooling, (3) information on income related characteristics to be used in the regression, and (4) general information. After the initial interviewing was completed, a total of 45 Gaston Tech and 45 high school graduates had been included in the study. The sample members came from 41 North Carolina high schools. A second contact was made with each of the 90 sample members in the summer of 1964 to obtain an additional year of income and employment information.

## INCOME

The average monthly income of Gaston Tech graduates was higher than that of high school graduates immediately after Gaston Tech graduates completed technical schooling. Initially, the difference in monthly incomes was only $11, but the gap widened rapidly. By the end of the first year of postgraduate employment the Gaston Tech group earned an average of $56 per month more than high school graduates. At the end of four years the difference had increased to $107 per month (Figure 1).

Incomes of high school graduates were more variable than those of Gaston Tech graduates (Table 2). The variability comparisons in Table 2 are spaced at one-year intervals in the period following technical schooling. The coefficient of variation of high school incomes was much larger than for Gaston Tech incomes. However, the coefficient of variation of high school incomes declined over the four-year period whereas the coefficient of variation for Gaston Tech incomes continued to increase directly with the length of time since graduation.

Table 2. Average monthly incomes of Gaston Tech and high school graduates for specified months after Gaston Tech graduates completed technical schooling

| Month | Gaston Tech | | High School | |
|---|---|---|---|---|
| | Income | Coefficient of variation[a] | Income | Coefficient of variation[a] |
| | (dollars) | | (dollars) | |
| 2 | 353 | 12.0 | 315 | 33.1 |
| 14 | 404 | 12.3 | 331 | 29.9 |
| 26 | 442 | 14.5 | 351 | 29.2 |
| 38 | 483 | 14.8 | 370 | 28.9 |
| 50 | 516 | 17.0 | 405 | 25.6 |

[a]The coefficient of variation is the standard deviation of monthly incomes expressed as a percentage of the mean.

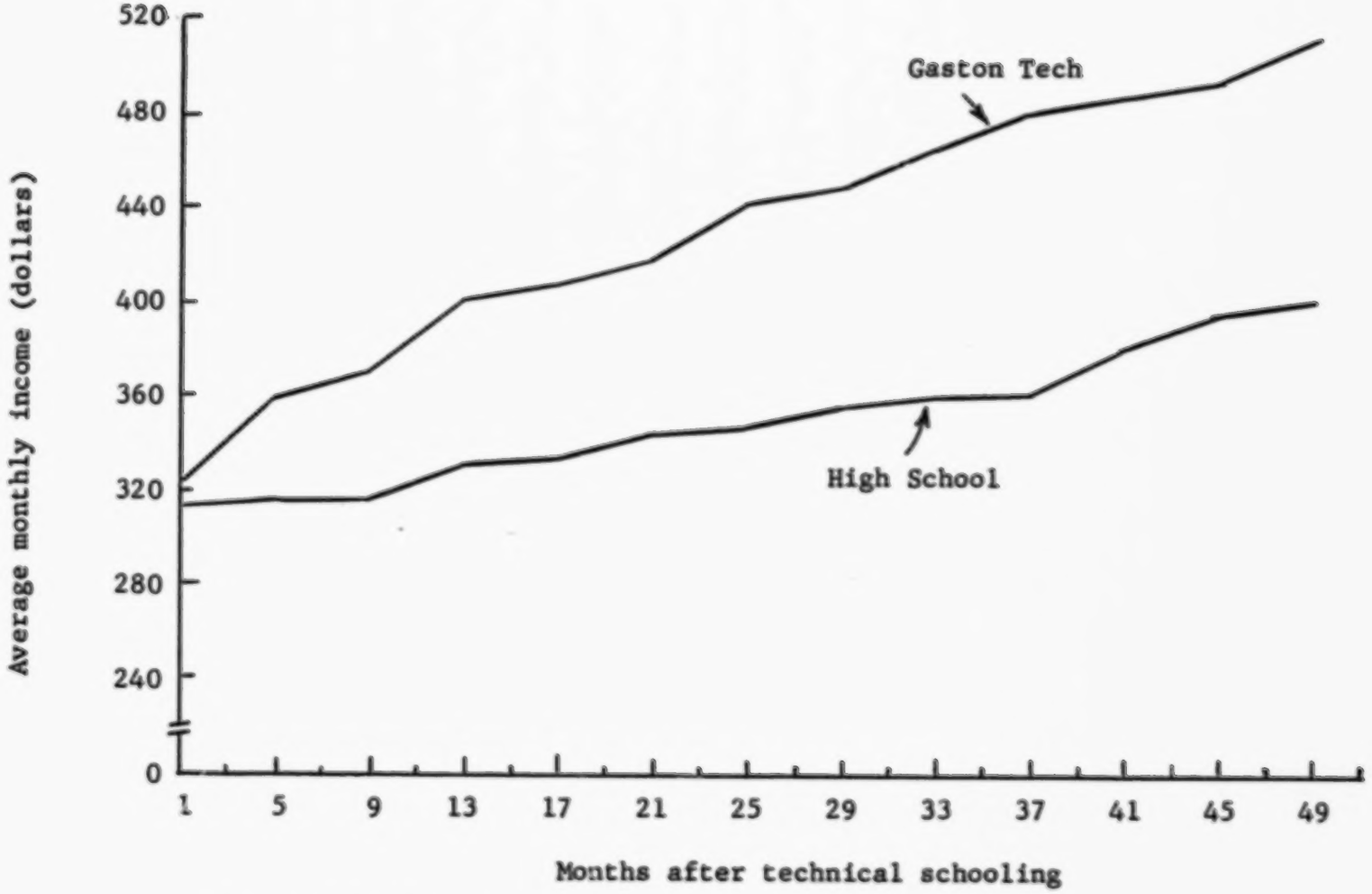


Figure 1. Monthly incomes of Gaston Tech and high school graduates at four-month intervals after Gaston Tech graduates completed technical schooling

Unemployment for a single individual in a particular month could noticeably affect the average income for that month. As a factor in determining the costs and returns of technical education, unemployment was not important. The income data were not adjusted for level of unemployment, and level of unemployment was not included as a variable in the regression analysis. High school graduates had less than 0.3 percent unemployment and Gaston Tech graduates had less than 0.2 percent unemployment.

## Regression Results

A more precise estimate of the income effect of technical education is obtained from the regression than by a simple comparison of the incomes of high school and Gaston Tech graduates (Table 3). The coefficient for technical education ($38.98) is the estimated monthly income advantage of Gaston Tech graduates immediately after graduation. The trend coefficients indicate an average increase of $3.42 per month in the monthly income of Gaston Tech graduates as opposed to $2.30 for high school graduates. Thus, the initial income advantage ($38.98) held by Gaston Tech graduates grew at an estimated rate of $1.12 per month, yielding an estimated income advantage of $40.10 in the first month after graduation.

Since the monthly income advantage of Gaston Tech graduates increased at the rate of $13.44 per year ($1.12 per month), the annual income advantage increased at the rate of $161 per year. Thus, the estimated income advantage held by Gaston Tech graduates increased from $553 in the first postgraduate year to $1,036 in the fourth year after technical schooling.

Table 3. Regression coefficients and standard errors[a]

| Variable | Coefficient | Standard error |
|---|---|---|
| | (dollars per month) | |
| $X_1$ - Technical education | 38.98** | 4.63 |
| $X_2$ - High school grade average | 15.76** | 2.23 |
| $X_3$ - Age-experience | 18.38** | .44 |
| $X_4$ - Mother's education | 9.43** | .48 |
| $X_5$ - Residence during high school | 31.77** | 2.53 |
| $X_6$ - Military service | -1.53** | .08 |
| $X_7$ - Migration from home community | .23** | .03 |
| $X_8$ - Size of high school class | - .08** | .01 |
| $X_9$ - Trend - Gaston Tech | 3.42** | .09 |
| $X_{10}$ - Trend - high school | 2.30** | .09 |
| Constant term | -320.82 | |
| Standard error of regression ($Y.X_{1-10}$) | 72.43 | |
| Fraction of total variation associated with regression ($R^2$) | .55 | |

[a]Based on 4,759 observations of monthly income.

**Coefficients are significant at the .01 level.

A simple comparison of the incomes of Gaston Tech and high school graduates would have resulted in much higher estimates of the annual income advantage of Gaston Tech graduates. Such a comparison would have produced estimates of $573, $917, $1202 and $1291 as the annual income advantage for Gaston Tech graduates during the first four years after schooling. The use of multiple regression to hold other important variables constant and obtain a more accurate estimate of the income effect of technical education resulted in smaller estimates than with a simple income comparison.

The coefficients of all of the independent variables in the regression equation had the expected sign except for military service ($X_6$) and size of high school graduating class ($X_8$). Since military service involves disciplinary training and, in some cases, occupational training, one would expect military service to have a positive effect upon an individual's earnings. However, persons receiving occupationally related training during military service were excluded from this study. Also, length of post-high school civilian employment varies directly with age, and inversely with length of military service, given age. Thus, the negative coefficient may indicate that military service unrelated to occupation is a poor substitute for civilian employment experience as a means of increasing earning power in a civilian occupation.

Size of high school graduating class was included in the regression as a measure of quality of secondary schooling. It was hypothesized that both the quantity and quality of courses offered would vary directly with size of high school. The residence variable may have served the

purpose for which size of high school class was intended. Given quality of schooling, the negative coefficient for size of high school class may simply represent the adverse effects of crowding and anonymity.

## Fringe Benefits

Some of the benefits of education may take the form of "fringe benefits." Payments in kind or unusual costs associated with a specific employment were considered as fringe benefits. The amount of leisure, retirement and insurance benefits, special clothing or equipment required of an employee, and paid sick leave are examples of either positive or negative benefits. The real value of a specific type of fringe benefit depends so heavily on individual preferences that it is difficult to determine the monetary value. Nevertheless, such benefits should not be ignored.

Although the measures for comparing fringe benefits between high school and Gaston Tech graduates are crude, such measures indicate which group has the advantage in each type of fringe benefit, even though the magnitude of the difference cannot always be determined. Some comparisons by type of fringe benefit are given in Table 4. The data are based on employment as of June 1, 1963.

The normal work week of Gaston Tech graduates averaged 2.7 hours per week less than for high school graduates. Gaston Tech graduates averaged 9.8 days of paid vacation and 6.7 paid holidays per year. Comparable figures for high school graduates were 8.9 and 5.5, respectively. Thus, on an annual basis, the Gaston Tech graduates had an average of 157 more hours available for leisure because of their shorter work week, longer paid vacations and more paid holidays.

Table 4. Summary of fringe benefits for employment as of June 1, 1963

| Item | Unit | Gaston Tech[a] | High school |
|---|---|---|---|
| Average working time (required hours) | hours/wk | 40.5 | 43.2[b] |
| With paid overtime | persons | 21 | 19 |
| Average overtime (for those with) | hours/wk | 3.9 | 4.4 |
| Receiving no paid vacations | persons | 1 | 2 |
| Average paid vacation | days | 9.8 | 8.9 |
| Receiving no paid holidays | persons | 3 | 7[c] |
| Average number of paid holidays | days | 6.7 | 5.5 |
| Receiving no paid sick leave[d] | persons | 9 | 13 |
| Average maximum paid sick leave (for those with)[e] | days | 30 | 24 |
| Having to furnish durable capital[f] | persons | 9 | 8 |
| Average amount of durable capital (for those furnishing) | dollars | 35 | 142 |
| Having to furnish nondurable capital[g] | persons | 0 | 2 |
| Average annual amount of nondurable capital (for those furnishing) | dollars | -- | 38 |
| Employer sponsored insurance | programs | 42 | 38 |
| Participating in sponsored life insurance | persons | 39 | 36 |
| Employer's average share of life insurance premiums (for those sponsoring)[h] | percent | 81 | 71 |
| Participating in sponsored hospital insurance | persons | 42 | 36 |
| Employer's average share of hospital insurance premium (for those sponsoring)[h] | percent | 72 | 71 |

Table 4 (continued)

| Item | Unit | Gaston Tech[a] | High school |
|---|---|---|---|
| Employer sponsored retirement | programs | 37 | 27 |
| Employer's share of contributions to retirement (for those sponsoring)[h] | percent | 86 | 82 |

[a]Three Gaston Tech graduates were in restricted categories as of June 1, 1963, and were not included in this table.

[b]Average does not include information for one high school graduate who did not work regular hours and received payment on a piece rate basis.

[c]Two of the seven high school graduates received extra pay for working holidays.

[d]In addition to those who did not have paid sick leave, six Gaston Tech graduates and seven high school graduates did not know whether paid sick leave was available or not.

[e]Average does not include information for five Gaston Tech graduates and three high school graduates who claimed to have an unlimited amount of paid sick leave.

[f]Durable capital includes tools and other hardware which with normal care could be used for several years.

[g]Nondurable capital includes items of clothing.

[h]The number of Gaston Tech graduates who did not know their employer's share of premiums was as follows: life insurance (15), hospital insurance (17), and retirement (18). The number of high school graduates who did not know their employer's share of premiums was as follows: life insurance (12), hospital insurance (15), and retirement (8).

What is the value of this extra leisure time? One estimate could be obtained by considering the value of leisure to be the same for the employee as his labor is to the employer. In this manner the greater amount of leisure time available to Gaston Tech graduates could be valued at the average hourly earnings rate for the group. Using this method to place a value on the extra leisure available to Gaston Tech graduates yields an estimate of $446 per year. The use of average hourly earnings would tend to overvalue leisure if Gaston Tech graduates were willing to work the additional hours for less than their average rate of pay. On the other hand, Gaston Tech graduates might be unwilling to work the extra hours unless they were paid a higher than average rate. If this is true, the leisure time would have a higher value than estimated above.

Only a small fraction (about 1/5) of each group was required to furnish some special equipment or clothing in occupations held as of June 1963. Both the average investment in durable capital such as tools and the annual cost of nondurables such as clothing were larger for high school graduates.

There was considerable uncertainty among members of both groups concerning the amount of paid sick leave available and the share of life and hospital insurance premiums paid by employers. Members of both groups were equally uncertain about the coverage of insurance policies obtained through employer sponsored programs as well as the costs and benefits of retirement programs.

The limited information on fringe benefits does suggest that Gaston Tech graduates had more of each type of benefit and less of each type of cost (Table 4). No attempt has been made to adjust the income difference between the two groups for differences in fringe benefits. To the extent that the Gaston Tech group receives greater value in fringe benefits, the real rate of return on investments in technical education will be underestimated.

## COSTS

The cost computations in this section are based on a model period of 21 months from enrollment to graduation. There were eight exceptions among the 45 Gaston Tech graduates, but only two persons required more than 18 months of actual schooling. The other six began their schooling in February of 1958 so that two summers intervened during the period of schooling. The average period of schooling for the 45 Gaston Tech graduates was increased by about two weeks as a result of these eight exceptions. Since the entire month of September was treated as a school month, even though schooling normally begins about the middle of September, the actual average period of enrollment was approximately 21 months.

### Social Costs

The social costs of technical education include the loss of productivity by students while attending school plus the factor costs of providing school facilities, supplies and personnel (Table 5).

Table 5. Average social cost per student for two years of technical education

| Item | Foregone productivity | School facilities, supplies and personnel | Total |
|---|---|---|---|
| | (dollars) | | |
| 1st year[a] | 2,408 | 1,143 | 3,551 |
| 2nd year | 2,789 | 1,085 | 3,874 |
| Total | 5,197 | 2,228 | 7,425 |

[a]Costs for the first year included only those applicable to the first two semesters of schooling. Summer months were counted in the second year.

Loss of productivity is reflected by the difference in labor earnings of students versus nonstudents. While the Gaston Tech students were obtaining technical education they gave up the opportunity for full-time employment. Instead of going to school they could have been working as high school graduates. Thus, the average income of high school graduates provides a basis for estimating income foregone. Regression coefficients were used to adjust the estimate of foregone earnings for differences in demographic characteristics between the two groups.

High school graduates earned an average of $2,509 while Gaston Tech students obtained their first academic year of schooling. During the summer and second academic year, high school graduates earned an average of $3,604. Since the monthly income effects of several demographic variables were estimated in the regression equation, actual average income earned by high school graduates was adjusted to represent the best estimate of what high school graduates would have earned if they had possessed the same demographic characteristics as Gaston Tech graduates. The adjustment was made by subtracting the average value of each regression variable for the high school group from the average value of the same characteristic of the Gaston Tech group.[11] The

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[11]The average value of high school demographic variables was unstable during the period in which Gaston Tech graduates were obtaining technical education. There were two reasons for the instability. First, the distance migrated or the amount of military service changed for some high school graduates. Second, restrictive sample criteria resulted in temporary exclusions of individuals which in turn affected both the average level of income and averages for demographic characteristics. Separate adjustments in the earnings of high school graduates were made for the two years of schooling because the demographic characteristics were variable. Adjustments were made for differences in high school grades, age, mother's education, residence during high school, military service, and size of high school graduating class. No adjustment was made for migration under the assumption that, as high school graduates in the labor force, Gaston Tech graduates would have migrated about the same distance as their high school classmates.

difference was then multiplied by the corresponding regression coefficient and this amount added to average high school earnings. The result may be interpreted as the average income which Gaston Tech students could have earned as high school graduates if they had not attended Gaston Tech. The estimated average labor income which Gaston Tech students could have earned during the school period was $2,447 for the first two semesters and $3,487 for the intervening summer and the last two semesters. As students, their actual incomes were considerably less.

Gaston Tech students earned an average of $39 through part-time employment during the first two semesters of schooling and $135 during the last two semesters. Only four students were employed part-time during their first two semesters at Gaston Tech but 12 worked part-time during the last two semesters. Thirty-nine students were employed during summer months between school terms. The average summer earnings for the forty-five Gaston Tech students amounted to $563. Thus, during the 21 months from enrollment to graduation, Gaston Tech graduates earned an average of $737. Since their potential earnings as high school graduates was estimated at $5,934, the estimated total loss of productivity averaged $5,197 per student.

The costs of providing physical facilities and personnel at Gaston Tech were estimated by adding the funds derived through state appropriations to the student payments. The public cost of operation and maintenance of Gaston Tech amounted to an average annual sum of $145,848 during the

school years 1957-1960.[12] Based on an average enrollment of 200 students during this period, public support of the school for two years averaged $1,458 per student (Table 6).

Table 6. Average private and public cost per Gaston Tech graduate for two years of technical schooling

| Type of cost | First year | Second year | Totals |
|---|---|---|---|
| | | (dollars) | |
| Private | | | |
| Tuition and fees | 272 | 272 | 544 |
| Books and supplies | 142 | 84 | 226 |
| Foregone income | 1896 | 2254 | 4150 |
| Total (private) | 2310 | 2610 | 4920 |
| Public | | | |
| Support of the school (facilities, supplies and personnel) | 729 | 729 | 1458 |
| Transfer payments (G. I. Bill and unemployment) | 512 | 535 | 1047 |
| Total (public) | 1241 | 1264 | 2505 |
| Total (social) | 3551 | 3874 | 7425 |

[12] The Budget, 1959-1961, Vol. 1, North Carolina Budget Division, Raleigh, 1959, pp. 327-328.

Budgeted costs did not include opportunity costs or depreciation of physical plant. The buildings in use at Gaston Tech were very old structures. It seemed unlikely that further depreciation of physical plant could more than offset the normal appreciation of site value. Opportunity costs of capital could have been estimated independently and added to state appropriations. However, budgeted costs for repairs and maintenance in 1957 exceeded by over $21,000 the average amount allotted to this category in succeeding years. In the writers' opinion, the opportunity return on real estate and physical capital employed at Gaston Tech would have been approximately this amount over the three-year period from 1957 to 1960. Consequently, budgeted costs financed through state appropriations were taken, without adjustment, as a good estimate of the public cost of providing school facilities and personnel.

The school administration at Gaston Tech provided estimates of the average cash expenditures required of students while attending the school. Average tuition for the Gaston Tech graduate of 1959 and 1960 was $136 per semester. Books and miscellaneous school supplies cost an average of $100 per student for the first semester and $42 for subsequent semesters. The estimated costs of student supplies were based on records of a student supply store operated by the institution.

On the basis of four semesters of time to complete the requirements of a curriculum at Gaston Tech, the average outlay per student during his schooling was $770, $544 for tuition plus $226 for books and supplies. No cost was included for room and board because there is little evidence that cost of living is significantly different between students and

nonstudents. The total estimated factor costs of providing school facilities, supplies and personnel averaged $2,228 per student, $770 direct expenditures by students plus $1,458 public support. Including the average loss of productivity per student ($5,197) the estimated average social cost of providing two years of post-high school, technical education was $7,425 per student (Table 5).

## Private Costs

The social costs of technical education were shared by students and others in society. In this analysis those costs of schooling which were financed by state or federal government are called public costs. All nonpublic costs were financed by the student, family, friends or nongovernmental organizations and are called private costs. Private costs are less than social costs because there were direct and indirect government transfer payments which reduced the amount financed from private sources.

The average private cost of school facilities, supplies and personnel amounted to $770 ($544 for tuition and $226 for books and supplies). The private share of foregone income was estimated by subtracting government transfer payments from total foregone income. During the first school year G. I. Bill payments averaged $512 per student. In the second year G. I. Bill payments averaged $516. In addition, unemployment payments in the summer months amounted to an average of $19 per student.

Total government transfer payments in the form of G. I. Bill to nineteen students and unemployment payments to three students reduced the average private foregone income to $4,150 for the forty-five

Gaston Tech graduates ($5197 minus $1047). Thus total private cost for the two years of technical schooling averaged $4,920 per student as compared to an average social cost of $7,425 (Table 6).

## PROJECTED INCOME

Since available income data following technical schooling were generally limited to a four-year period, it was necessary to estimate future lifetime income that would be earned as a result of technical schooling before computing a rate of return. Two projections of future income differences between Gaston Tech and high school graduates were made. The first projection is rather conservative, and the second projection is rather optimistic. These two projections cover the range of possible future outcomes which seemed reasonable.

### Projection Number One

The first projection was based on the assumptions that; (a) Gaston Tech graduates reached their maximum income advantage over high school graduates in the fourth year after graduation from Gaston Tech, and (b) thereafter the income difference would be constant during the work life of both groups. The average age of both groups in the fourth year was 27, and a retirement age of 65 was assumed. Thus, the annual income advantage of $1,036 was projected for 38 years to retirement age 65 (Table 7).

A projection of the income difference does not necessarily imply a particular rate or direction of change in the incomes of either group. Projection number one could be accurate under conditions of rising, constant or falling incomes provided the absolute annual difference in average incomes remains $1,036. No secondary data were found to support such a projection. Nevertheless, projection number one was useful because the estimates of the rate of return on technical education which are based on the projection are considered very conservative.

Table 7. Average annual income advantage projected for Gaston Tech graduates by year of postgraduate work experience, age, and projection[a]

| Post-graduate year | Average age | Projection number | | Post-graduate year | Average age | Projection number | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | | | 1 | 2 |
| | | (dollars) | | | | (dollars) | |
| 1 | 24 | 553 | 553 | 22 | 45 | 1036 | 3107 |
| 2 | 25 | 714 | 714 | 23 | 46 | 1036 | 3217 |
| 3 | 26 | 875 | 875 | 24 | 47 | 1036 | 3327 |
| 4 | 27 | 1036 | 1036 | 25 | 48 | 1036 | 3437 |
| | | | | 26 | 49 | 1036 | 3547 |
| 5 | 28 | 1036 | 1153 | 27 | 50 | 1036 | 3657 |
| 6 | 29 | 1036 | 1270 | 28 | 51 | 1036 | 3703 |
| 7 | 30 | 1036 | 1387 | 29 | 52 | 1036 | 3749 |
| 8 | 31 | 1036 | 1504 | 30 | 53 | 1036 | 3795 |
| 9 | 32 | 1036 | 1621 | 31 | 54 | 1036 | 3841 |
| 10 | 33 | 1036 | 1738 | 32 | 55 | 1036 | 3887 |
| 11 | 34 | 1036 | 1855 | 33 | 56 | 1036 | 3933 |
| 12 | 35 | 1036 | 1972 | 34 | 57 | 1036 | 3979 |
| 13 | 36 | 1036 | 2089 | 35 | 58 | 1036 | 4025 |
| 14 | 37 | 1036 | 2206 | 36 | 59 | 1036 | 4071 |
| 15 | 38 | 1036 | 2323 | 37 | 60 | 1036 | 4117 |
| 16 | 39 | 1036 | 2440 | 38 | 61 | 1036 | 4163 |
| 17 | 40 | 1036 | 2557 | 39 | 62 | 1036 | 4209 |
| 18 | 41 | 1036 | 2667 | 40 | 63 | 1036 | 4255 |
| 19 | 42 | 1036 | 2777 | 41 | 64 | 1036 | 4301 |
| 20 | 43 | 1036 | 2887 | 42 | 65 | 1036 | 4347 |
| 21 | 44 | 1036 | 2997 | | | | |
| | | | | Total | | 42,546 | 119,288 |

[a]The estimated average income advantage for the first four years after graduation is given along with projected income advantage to yield a total estimate of the lifetime returns on technical education for those who retire at age 65. The projections represent trends in the income difference between Gaston Tech and high school graduates as follows:

(1) No change

(2) Cross-section profile, 2 percent growth.

## Projection Number Two

A second projection was made on the basis of cross-section data from the 1960 census. The difference in mean annual earnings of high school graduates and persons with 1-3 years of college was computed for each age category (Table 8). Differences in the income advantage from one age category to the next were divided by 10 to obtain an estimate of the change in the annual income difference between age categories.

Table 8. Mean earnings of southern white males in the experienced civilian labor force by age and years of school completed, 1959[a]

| Age | High school | 1-3 years of college | Difference | Average annual change |
|---|---|---|---|---|
| | | | (dollars) | |
| 25 - 34 | 5010 | 5347 | 337 | |
| | | | | 76 |
| 35 - 44 | 5822 | 6919 | 1097 | |
| | | | | 43 |
| 45 - 54 | 5853 | 7383 | 1530 | |
| | | | | -6 |
| 55 - 64 | 5528 | 7000 | 1472 | |

[a]The census definition of earnings includes income earned as wages, salary, commissions, tips, and profits or fees from self-employment.

Means were computed exclusive of three occupational categories which, by census definitions, have a relatively high proportion of self-employed. The categories excluded were: (1) farmers and farm managers, (2) managers, officials, and proprietors, except farm, and (3) farm laborers and foremen.

Source: U. S. Census of Population, 1960, Occupation by Earnings and Education, U. S. Department of Commerce, Washington, D. C., pp. 220-237.

Differences in the annual earnings of persons by age and level of education at a moment in time do not provide a true picture of the income pattern of persons aging over time. Only in a stationary state with zero growth in wages could cross-sectional data provide a good estimate of future earnings by age and education categories. Becker[13] suggests that ". . . secular growth in real earnings per capita would usually enable the cohort of persons graduating from high school or college in any year to earn more at each age than was earned in that year by persons who had graduated earlier."

Growth in productivity and earnings over time are not necessarily uniform by age, education or occupations. However, to adjust the cross-sectional data in Table 8 for secular growth, earnings were assumed to grow at the same rate for all age, education and occupation categories. An annual growth rate of 2 percent was applied to the data in Table 8. The average age of Gaston Tech and high school graduates in 1959 was 22 years. Therefore, mean earnings in Table 8 were adjusted upward at the rate of 2 percent per annum for the number of years that will elapse from 1959 until sample members reach the mid-point of each age category. The resulting income estimates were used to derive estimates of the average annual growth in the income difference from one age to the next (Table 9). The

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[13] Becker, op. cit., p. 73. Becker referred to 1.25 percent as the most plausible rate of growth in real income per capita. However, he estimated the rate of return on investments in college education using income growth rates of zero, 1, and 2 percent.

Table 9. Estimated mean earnings of southern white males in the experienced civilian labor force who were 22 years old in 1959 (assuming a 2 percent rate of growth in annual earnings) by age and years of school completed

| Age | Years of growth | High school | 1-3 years of college | Difference | Average annual change |
|---|---|---|---|---|---|
| | | | (dollars) | | |
| 30 | 8 | 5,870 | 6,265 | 395 | |
| | | | | | 117 |
| 40 | 18 | 8,315 | 9,882 | 1567 | |
| | | | | | 110 |
| 50 | 28 | 10,190 | 12,854 | 2664 | |
| | | | | | 46 |
| 60 | 38 | 11,732 | 14,856 | 3124 | |

figures in column six of Table 9 were then used to project the future income advantage of Gaston Tech graduates (projection number two in Table 7 and Figure 2).

## Adjustments for Mortality Rates

The income advantage estimated for Gaston Tech graduates in the first four years after graduation has already been earned. Any income advantage projected for future years can only be earned by Gaston Tech graduates who are working during those years. Gaston Tech graduates who do not live to retirement age would be unable to obtain all the projected returns from their investment in technical education.

The probability of preretirement deaths can be estimated from survival data. In 1962, the Bureau of Vital Statistics published the number of survivors by age from 100,000 live, white male births. The average age of the group of Gaston Tech graduates in 1964 was 27 years. Survival rates used to adjust projected returns were computed by dividing the number of 27-year old white male survivors into the

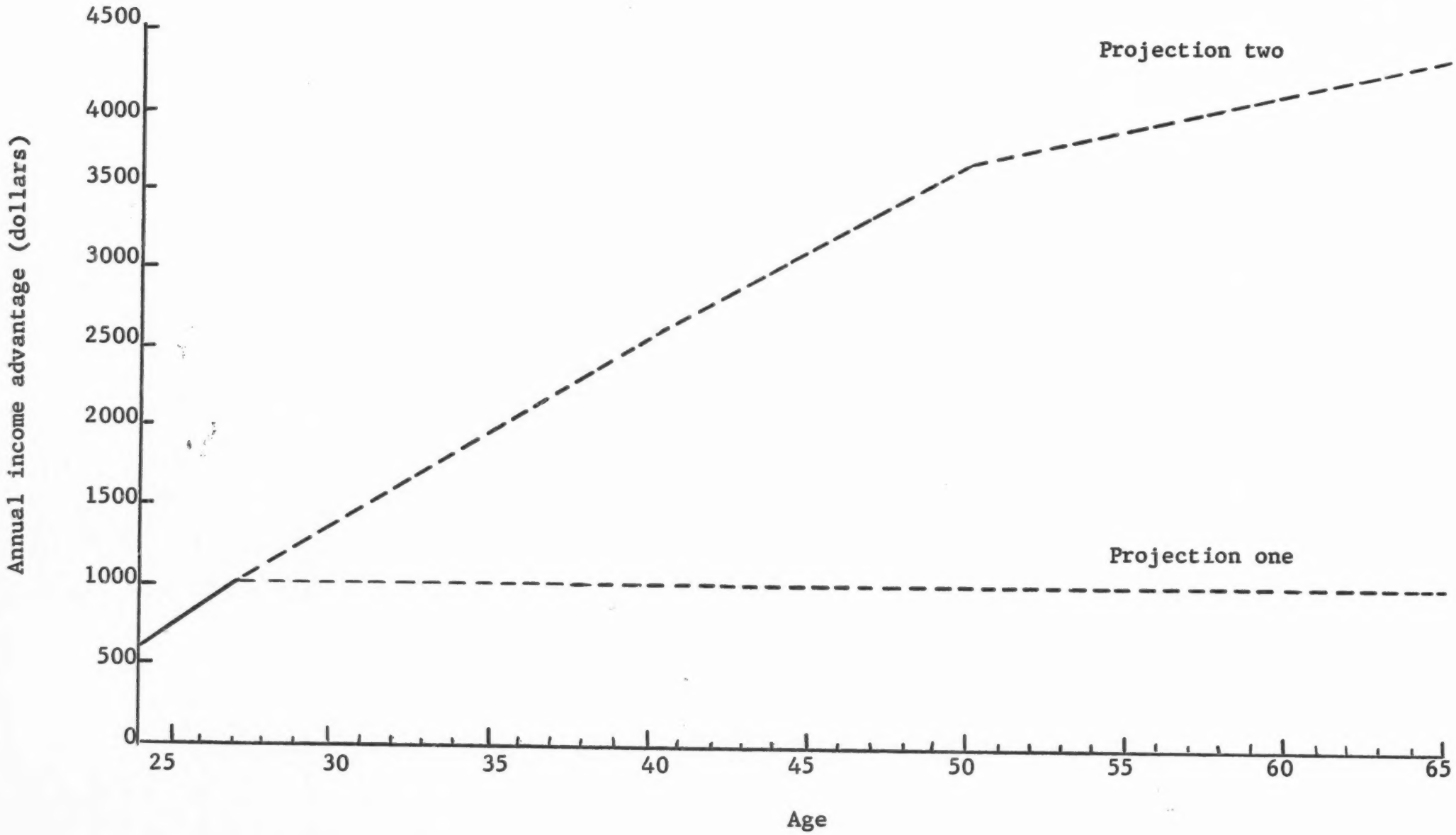


Figure 2. Average annual income advantage projected for Gaston Tech graduates by age and projection number

number of survivors at each subsequent age up to 65. The resulting figures represent the best current estimate of the probabilities of a 27-year old white male living to any particular age from 27 to 65. Mortality rates were assumed to be the same for Gaston Tech and high school graduates. Mortality rates are normally lower for people with higher education because of differences in the types of occupations, expenditures on health care, and other factors related to level of education or income. However, any difference in the future mortality rates of Gaston Tech and high school graduates was expected to be negligible because the difference in formal education is only two years.

After the survival rates were computed, each year's projected annual income differential was multiplied by the probability of survival to the corresponding age. For example, the probability of a 27-year old white male reaching age 65 is computed by the above procedure to be .69. Thus, the probability of a Gaston Tech graduate living to earn the income advantage projected for the last year before retirement is approximately .69. When the projected earnings were multiplied by survival rates, the returns from investment in technical education were adjusted for one of the important risks affecting the value of human capital -- the uncertainty of life.

The use of historical survival data probably resulted in an overestimate of future mortality rates because there was no adjustment for scientific advancements that tend to increase life expectancy. However, other employment reducing factors such as disability and early retirements may offset the overadjustment for mortality. As in the case

of mortality, Gaston Tech and high school graduates may have a different rate of incidence for such factors. To the extent that Gaston Tech graduates have lower incidence of these employment reducing factors than high school graduates, as would normally be expected, the returns estimated for investments in technical education are conservative.

## RATES OF RETURN

The rates of return on investments in technical education were determined by finding interest rates at which the sum of discounted monetary costs would equal the sum of discounted monetary returns. The interest rates which would satisfy this condition were found by an iterative process. Rates of return represent compount interest earned on the investment. Thus, the income from investment in technicai education must be sufficient to repay the investment costs plus interest on the investment (compounded annually) at the rate which is called the rate of return.

### Social Rate of Return

Since external and nonmonetary effects of education have not been estimated in this study, the estimated monetary returns to society are identical to private monetary gains before taxes. The estimated social rate of return was less than the estimated private rate of return because part of the investment in technical education was publicly financed.

The rate of return on society's investment in the technical education of Gaston Tech graduates was estimated at 16.5 percent. Even without any growth in the future income difference, the estimated rate of return was 11.7 percent (Table 10).

### Private Rate of Return

The private rate of return was computed for each projection on the basis of investments made by Gaston Tech graduates which were privately financed. The private rate of return represents the estimated rate of

Table 10. Rates of return on investment in the technical education of Gaston Tech graduates by projection

| Investment | Projection one | Projection two |
|---|---|---|
| | (percent) | |
| Social | 11.7 | 16.5 |
| Private | 16.9 | 22 |
| Private[a] | 14.3 | 19.1 |

[a]Without G. I. Bill payments.

interest for Gaston Tech graduates who had average costs and obtain average returns on their investment in technical education.

The estimated private rate of return is 22 percent. With no change in the earnings differential between high school and Gaston Tech graduates, the estimated private rate of return is 16.9 percent. If Gaston Tech graduates had not received payments under the G. I. Bill of Rights, average private costs would have been $1,028 higher. The estimated private rate of return would be only 19.1 percent, almost three percentage points lower than the estimated rate when the payments are included.

Private rates of return were computed on costs and returns before income taxes. If income taxes had been estimated, both foregone private earnings during school and the income advantage after schooling would be reduced. Since foregone earnings constituted 84 percent of private costs, adjusting for income tax payments would have had about the same relative effect on costs and returns. Progressive income tax rates would tend to raise the effective tax rate on returns above the rate

on costs. If the returns from investment in education are treated at the margin, as they should be, the income would tend to fall in a higher tax bracket as earnings increased. However, this tendency toward a higher income tax bracket is offset to some degree by the tendency of an increase in the number of dependents which reduces taxable income. After all factors are considered, the private rate of return after taxes would be only about one percentage point less than the private rate of return before taxes.

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